FIGS. 7 and 8 are specific embodiments that show various operational parameters that may be monitored for IPG service manager 640 and session manager 650, respectively. Other parameters may also be monitored, and additional and/or different information may also be reported by the status monitors. The reported information may include status relating to various operations performed at the head-end, statistical information, events, end-to-end system related information such as customer trend, IPG usage information, and so on, some of which are described in the aforementioned U.S. Patent Application Serial No. 60/253417 (Attorney Docket No. 19880-003800). The status monitors may also be designed with different layouts, configurations, and arrangements. These and other variations are within the scope of the invention

For a system used to distribute information (e.g., programming, guide data, and so on) to a large number of terminals, it is often very important to maintain the system up and running at all times and to minimize down time. This typically requires constant (24-hour) monitoring of the operational status of the system elements, spotting for potential problems, and correcting any problems that may arise. Technician and/or other personnel may be employed on-site to stand on alert and to remedy any problems that may arise.

Remote monitoring and control of such distribution system is highly desirable for many reasons. For example, personnel may not be available on-site to monitor the system. Moreover, the on-site personnel may require additional assistance from other personnel whom may be located off-site. For these and other reasons, remote monitoring and control by off-site personnel is highly desirable.

Referring back to the embodiment shown in FIG. 6, monitor and control unit 660 further communicates with a (e.g., Web) server 662 for exchanging data and messages with off-site personnel. Server 662 can further communicate with a number of remote devices 670, and acts as a conduit for exchanging data and messages between monitor and control unit 660 and these remote devices. Such remote devices may include, for example, a cellular phone 670a, a pager 670b, a personal digital assistance (PDA) 670c (e.g., Palm VII from Palm, Inc.), and others.

In an embodiment, the type and format of information to be provided to remote devices 670 are dependent on the particular design and capabilities of the remote devices. For example, since pagers are typically only able to receive text messages, monitor and control unit 660 provides information in text format to these pagers. PDAs,

PID can be dropped at anytime in a GOP since it is not used as a reference for prediction by any other frame in the GOP.

The temporal slice persistence technique can be advantageously employed in a broadcast scenario whereby a large number of guide PIDs (in the order of hundreds) can be efficiently delivered. Since the guide PIDs do not carry full motion barker video, huge bandwidth savings can be achieved. The barker video can be sent as a separate video stream (e.g., V-PID or another PID). The temporal slice persistence technique can also be used to implement other combinations of coding and decoding of guide frames, full motion video frames, and (possibly) other multimedia information in a GOP. The temporal slice persistence technique employs picture-based recombination techniques with slice-based sub-picture updating mechanisms, as described in the aforementioned U.S. Patent Application Serial No. ~~(Attorney Docket No. 19880-003410).~~ 09/686739

By exploiting known characteristics of the IPG pages and the temporal slice persistence technique, the transmission of redundant information can be minimized, for example, by employing efficient client-server communication and acknowledgement techniques. For example, the guide portion of a requested IPG page may be sent a limited number of times (e.g., once) in response to a viewer request for the page. This "strobecast" of IPG pages can greatly reduce the load for demand-cast, and may (possibly) be used for the delivery of other contents from the head-end. Strobecast techniques are described in detail in the aforementioned U.S. Patent Application Serial No. 09/687,662.

D. SPOTLIGHT WINDOW

FIG. 4 is a diagram of a specific design of a channel information window 400 (also referred to as a "spotlight window") that can also be used to efficiently provide IPG information. The spotlight window can be generated and overlay on top of a video display (e.g., whenever selected by a viewer). In this design, spotlight window 400 includes a specific portion 410, a local portion 420, and a common portion 430. Specific portion 410 includes information specific to a particular broadcast channel being described by spotlight window 400. Local portion 420 includes information targeted for delivery to the terminals within a particular locality. And common portion 430 includes features that are common for a number of spotlight windows (i.e., the background that is common for all broadcast channels and localities). FIG. 4 shows a specific design, and

video V-PID via one of the picture-based recombination methods described in the aforementioned U.S. Patent Application Serial No. 09/686739 (Attorney Docket No. 19880-003410).

The selected guide page is decoded and displayed at t=15, with only the region that contains the guide portion slices being updated on the screen. From that time on, the guide portion of the screen is not updated (i.e., the guide slices temporally persist on the screen) until the viewer selects another guide page. This selection then updates the slices in the guide portion and rewrites the new guide portion on the screen. Similarly, the V-PID frames only change the video portion of the screen and do not update the guide portion, since these motion video frames do not include slices in the guide portion.

The embodiments disclosed with respect to FIG. 3C can be used for broadcast of IPG pages and can further be used for a demand-cast of IPG pages in response to viewer requests. For demand-cast, the head-end can time stamp the requested page to be processed and quickly displayed on the screen in a suitable time index within a GOP to reduce delays. The guide frames and motion video frames can be encoded, delivered, decoded, and displayed in various manners, as described in the aforementioned U.S. Patent Application Serial No. 09/686739 (Attorney Docket No. 19880-003410).

In another embodiment that is supported by FIG. 3C, the V-PID is encoded to include P and B pictures (e.g., a GOP of I-B-B-P-B-B-P-B-B-P-B-B-P-B-B), and any B picture in the V-PID can be dropped and replaced with a B-coded guide frame that includes "intra-coded" macroblocks. This can be achieved by adjusting the encoding threshold selection that decides whether a macroblock is better to be encoded as intra-coded or as predictive-coded. Any B-coded frame can be dropped and replaced since it is not used as a reference for prediction by any other pictures in a GOP. The guide page frames can be time stamped to be presented, for example, at t=2. Other embodiments for encoding and decoding the guide frames are described in the aforementioned U.S. Patent Application Serial No. 09/686739 (Attorney Docket No. 19880-003410).

FIG. 3D is a diagram that shows an implementation of demand-cast with the use of temporal slice persistence technique. In the example shown in FIG. 3D, a viewer request is received and processed by the head-end, and the requested guide PID is time stamped to be displayed at t=3. In this example, the V-PID is coded to include B frames (e.g., I-B-B-P-B-B-P…), and the B frame at t=3 is dropped and replaced with a B-coded requested guide PID that includes intra-coded macroblocks. The B frame of the V-

As shown in FIG. 3B, the coded slices for the guide and video portions of the IPG pages can be assigned to a number of PIDs. In FIG. 3B, only the content that is assigned a PID is delivered to the terminals. The intra-coded guide portions g_1 through g_{10} are assigned to PID 1 through PID 10, respectively. One of the common intra-coded video portion v_1 (e.g., for IPG page 10) is assigned to PID 11. In this form, substantial bandwidth saving is achieved by delivering the intra-coded video portion v_1 only once. Finally, the predictive-coded pictures g_1/v_2 through g_1/v_{15} are assigned to PID 12. Again, a substantial saving in bandwidth is achieved by transmitting only one group of fourteen predictive-coded pictures, g_1/v_2 through g_1/v_{15}. The PID assignment and decoding processes are described in the aforementioned U.S. Patent Application Serial No. 09/686732 ~~(Attorney Docket No. 19880-003410)~~.

FIG. 3C is a diagram of a data structure 340 that can be used in conjunction with temporal slice persistence encoding. Data structure 340 is a matrix representation for program guide data for a number of IPG pages based on the partitioning of the IPG page shown in FIGS. 2B and 2C. As shown by the shaded portions in FIG. 3C, a video sequence is formed which contains only the video portion of the IPG page (i.e., the portion containing time-varying information). In an embodiment, the coded video sequence contains only slices that belong to the video region. The coded video sequence is assigned a particular PID (e.g., V-PID) and transmitted from the head-end.

For each IPG page, the guide portion (i.e., the portion containing the information specific to that IPG page) is sent in a separate picture frame. Since the guide portion does not change over time, only one picture for each GOP is coded and transmitted. The coded guide frame contains only the slices that belong to the guide portion of a frame. The slice-coded guide portion for each IPG page is assigned a respective PID (e.g., G-PID) and also transmitted from the head-end.

The presentation times of the guide frames and motion video frames are assigned in accordance with a "temporal slice persistence" fact. In an embodiment (not represented in FIG. 3C), the guide PIDs (i.e., G-PID 1, G-PID 2, and so on) are time stamped to be presented at the end of each GOP at t=15. At t=15, the last motion video frame in the GOP is dropped and the viewer-selected guide page is presented. To achieve this, the video decoder re-combines the selected guide G-PID (e.g., G-PID 1) and the

coded picture sequence: I1, B1, B1, P1, B1, B1, P1, B1, B1, P1, B1, B1, P1, B1, and B1, where I represents an intra-coded picture, P represents a uni-directionally predictive-coded picture, and B represents a bi-directionally predictive-coded picture.

In the example shown in FIG. 3A, matrix 300 includes a group of intra-coded pictures 312 and a group of predictive-coded pictures 314 that can be used to fully represent the ten IPG pages. In an embodiment, intra-coded picture group 312 includes ten intra-coded pictures at time index t_1 for the ten IPG pages. These intra-coded pictures can be assigned to PIDs 1 through 10, which may also be referred to as I-PIDs 1 through 10 to denote that these PIDs include intra-coded pictures. In an embodiment, predictive-coded picture group 314 includes 14 predictive-coded pictures of one of the IPG pages for time indices t_2 through t_{15}. Predictive-coded picture group 314 is also assigned a PID, and may also be referred to as the base-PID or PRED-PID to denote that this PID includes predictive-coded pictures. The base-PID may comprise the following picture sequence: B1, B1, P1, B1, B1, P1, B1, B1, P1, B1, B1, P1, B1, and B1.

For each IPG page, between time t_1 to t_{15}, the guide portion does not change and only the video portion changes. In each column, the 14 prediction error frames contain zero data for the guide portion and video prediction error for the video portion. Therefore, the content of the base-PID is the same for each IPG page and may be sent only once per group of IPG pages in the matrix for each GOP period.

If a viewer wants to view the guide data for a particular group of channels (i.e., a particular IPG page), a demultiplexer at the terminal selects the I-PID for the selected IPG page and recombines the selected I-PID with the base-PID to produce a recombined stream, which is then decoded by the video decoder. Picture-level recombination is described in further detail in the aforementioned U.S. Patent Application Serial No. (Attorney Docket No. 19880-003410) 09/686739.

FIG. 3B depicts an embodiment of a data structure 320 that may be used in conjunction with slice-based encoding. In this example, ten IPG pages are available, with each page represented by a respective guide portion (g) and a common video portion (v). For example, IPG page 1 is represented as (g_1/v_1), IPG page 2 is represented as (g_2/v_1), and so on. In data structure 320, ten guide portions g_1 through g_{10} are associated with the video portion (v_1). Slice-based encoding is described in the aforementioned U.S. Patent Application Serial Nos. (Attorney Docket No. 19880-003410) 09/686739 and 09/635,508.

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others of which may be hidden. This mask or reveal technique can be used for any region of the IPG page.

The mask or reveal feature and the user interaction processing are described in the aforementioned U.S. Patent Application Serial Nos. 09/293,526 and 08/984,427.

A program guide for a large number of channels for a long time period can be very extensive. For example, 480 IPG pages would be needed to provide program guide for two weeks of programming for 200 channels, if each IPG page includes a program listing for 10 channels in two half-hour time slots as shown in FIG. 2A. A large amount of system resources (e.g., bandwidth) would be needed to continually transmit the complete program guide.

In an embodiment, to conserve system resources, only a limited number of IPG pages are continually sent (broadcast) by the head-end, and remaining IPG pages may be sent as requested by viewers. The specific number of IPG pages to be broadcasted and their selection are dependent on the particular system implementation, and may be defined by a time depth and a program depth for the program guide. The time depth refers to the amount of time programming for a particular channel group is provided by the broadcast video PIDs. And the channel depth refers to the number of channels available through the program guide (in comparison to the total number of channels available in the system).

In an embodiment, a number of video PIDs can be used to send the program guide for the current and (possibly) near look-ahead time slots, one or more audio PIDs can be used to send an audio barker, and (optionally) one or more data PIDs (or other data transport method) can be used to send the program description data, overlay data, and/or other data. The elementary streams carrying the IPG are sent in one or more transport streams.

For the portion of the program guide that is broadcasted by the head-end, a viewer is able to quickly retrieve and display IPG pages formed from the broadcast streams whenever desired.

If the viewer desires a program listing or other contents that is not provided by the broadcast streams, then a demand-cast session may be initiated, for example, as described in the aforementioned U.S. Patent Application Serial Nos. 09/687,662 and ~~(Attorney Docket No. 19880-003410)~~ 09/686759. For this demand-cast session, the

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LNE 104 can be programmed to extract specific information from the signal transmitted by the head-end. As such, the LNE can extract video and guide slices that are targeted to the viewers served by the LNE. For example, the LNE can extract specific channels for representation in the guide grid that can be made available to the viewers served by that LNE. In such case, unavailable channels to a particular neighborhood would not be depicted in a viewer's IPG. The IPG may also include targeted advertising, e-commerce, program notes, and others. To support such features, each LNE may recombine different guide slices with different video slices to produce IPG pages that are prepared specifically for the viewers served by that particular LNE. Other LNEs may select different IPG component information that is relevant for their associated viewers. A detailed description of LNE 104 is described in the aforementioned U.S. Patent Application Serial No. 09/635,508.

For a server-centric distribution system, the program guide resides at the head-end and a two-way communication system, via a back channel 164, is utilized to support communication with the terminals for delivery of the program guide. Back-channel 164 can be used by the terminals to send requests and other messages to the head-end, and may also be used by the head-end to send messages and certain types of data to the terminals. An out-of-band delivery system 170 facilitates the exchange of data over the back channel and forwards terminal requests to session manager 150.

Other elements within head-end 102 may also interface with out-of-band delivery system 170 to send information to terminal 108 via the out-of-band network. Fort example, a spotlight server that produces a spotlight user interface (described below) may interface with out-of-band delivery system 170 directly to send spotlight data to terminals 108. Off the shelf equipment including network controllers, modulators, and demodulators such as those provided by General Instrument Corporation can be used to implement out-of-band delivery system 170.

Distribution system 100 is described in further detail in the aforementioned U.S. Patent Application Serial Nos. 09/687,662 and 09/686739 ~~(Attorney Docket No. 19880-003410)~~. One specific implementation of head-end 102 is known as the DIVA™ System provided by DIVA Systems Corporation.

APPARATUS FOR TRANSMITTING VIDEO AND GRAPHICS IN COMPRESSED FORM," filed October 27, 1999. Temporal slice persistence encoding is described in detail in U.S. Patent Application Serial No. 09/686739 ~~(Attorney Docket No. 19880-003410)~~, entitled "TEMPORAL SLICE PERSISTENCE METHOD AND APPARATUS FOR DELIVERY OF INTERACTIVE PROGRAM GUIDE," filed October 10, 2000. Strobecast encoding and delivery is described in detail in U.S. Patent Application Serial No. 09/687,662, entitled "EFFICIENT DELIVERY OF INTERACTIVE PROGRAM GUIDE USING DEMAND-CAST," filed October 12, 2000. These applications are assigned to the assignee of the invention and incorporated herein by reference.

In the specific embodiment shown in FIG. 1, encoder unit 120 includes a guide data grid generator 122, a compositor unit 124, video encoders 126a and 126b, and an audio encoder 128. Additional video and/or audio encoders may also be included within encoder unit 120, depending on the particular head-end design. Guide data grid generator 122 receives and formats the guide data into a "guide grid", e.g., guide grid region 212 in FIG. 2A.

Compositor unit 124 receives and combines the guide grid from grid generator 122 and a video sequence from video source 112, and may further insert advertising video, advertiser or service provider logos, still graphics, animation, other information, or a combination thereof. In an embodiment, compositor unit 124 provides a background video (e.g., as shown in FIG. 2B) to a first video encoder 126a and a guide video (e.g., as shown in FIG. 2C) to a second video encoder 126b. For picture-based encoding, compositor unit 124 provides a composed video (e.g., as shown in FIG. 2A) to one video encoder. A number of encoders can be used to encode in parallel a number of composed videos for a number of IPG pages, with each IPG page including different guide content.

In an embodiment, video encoder 126a is a real-time (e.g., MPEG-2) encoder that encodes the background video using a particular encoding technique, and provides one or more (e.g., MPEG-2 compliant) bitstreams for the background portion of the IPG page. In an embodiment, video encoder 126b is a (e.g., software-based) encoder that encodes the guide video using a particular encoding technique, and provides one or more bitstreams that collectively represent all or a portion of the guide grid. Each video encoder 126 is designed to efficiently and effectively encode the respective input video, and may be operated in accordance with slice-based, picture-based, temporal slice

REMOTE MONITORING AND CONTROL METHOD AND APPARATUS FOR AN INFORMATION DISTRIBUTION SYSTEM

CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims the benefit of U.S. provisional Application Serial No. ~~(Attorney Docket No. 19880-003800)~~ 60/253417, entitled "METHOD AND APPARATUS FOR INTERACTIVE PROGRAM GUIDE AND ADVERTISING SYSTEM," filed November 27, 2000, which is incorporated herein by reference in its entirety for all purposes.

BACKGROUND OF THE INVENTION

The present invention relates to communication systems in general. More specifically, the invention relates to techniques to efficiently deliver interactive program guide (IPG) and other multimedia information in a server-centric system.

Over the past few years, the television industry has seen a transformation in a variety of techniques by which its programming is distributed to consumers. Cable television systems are doubling or even tripling system bandwidth with the migration to hybrid fiber coax (HFC) cable plant. Direct broadcast satellite (DBS) systems have also emerged as a viable alternative to customers unwilling to subscribe to local cable systems. A variety of other approaches have also been attempted, which focus primarily on high bandwidth digital technologies, intelligent two-way set top terminals, or other methods to try to offer services differentiated from those of standard cable and over-the-air broadcast systems.

For a system designed to distribute information (e.g., programming, guide data, and so on) to a large number of terminals, it is very important to maintain the system up and running at all times and to minimize down time. This typically requires constant (24-hour) monitoring of the operational status of the system elements, spotting for potential problems, and correcting any problems that may arise. Technician and/or other personnel may be employed on-site to stand on alert and to remedy any problems that may arise.

However, in certain instances, the necessary personnel may not be available on-site to monitor the system. Moreover, the on-site personnel may require additional assistance from other personnel whom may be located off-site. For these and